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ORIGINAL ARTICLE

Postoperative Sleep Outcomes in Empty Nose Syndrome: Associations With Psychiatric Symptomatology

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Received: 22 January 2025 | **Revised:** 1 May 2025 | **Accepted:** 11 May 2025

Funding: This work was funded by grants from Chang Gung Memorial Hospital (CMRPG1P0041).

Keywords: anxiety | depression | empty nose syndrome | minimally clinically important difference | sleep outcome | snore | surgery

ABSTRACT

Background: Empty nose syndrome (ENS) is an iatrogenic condition characterized by paradoxical nasal obstruction and significant impairments in mental status and sleep function. Reconstructive surgery aims to improve the symptoms and overall well-being of patients with ENS. In this study, we investigated the effects of reconstructive surgery on sleep outcomes in patients with ENS, emphasizing clinically meaningful improvements beyond questionnaire score changes.

Methods: We prospectively enrolled patients with ENS undergoing surgical reconstruction. We assessed patients pre-reconstructively and at 6 months post-reconstructively, including polysomnography (PSG) and using subjective questionnaires, including the Empty Nose Syndrome Six-Item Questionnaire (ENS6Q), Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (EpSS), Beck Depression Inventory-II (BDI-II), and Beck Anxiety Inventory (BAI).

Results: This study enrolled 39 patients undergoing surgical reconstruction. Post-reconstruction ENS6Q, PSQI, EpSS, BDI-II, and BAI scores improved significantly. Patients without post-reconstruction depressive symptomatology were 13 times more likely to achieve clinically meaningful improvements in PSQI scores. The snore index significantly decreased in patients without post-reconstruction anxious symptomatology, while other PSG parameters did not show significant changes following reconstruction.

Conclusions: Reconstructive surgery significantly alleviates subjective symptoms in ENS patients, while psychiatric status plays a pivotal role in determining sleep outcomes. These findings highlight the importance of a comprehensive treatment approach that integrates both nasal function restoration and psychiatric care for optimizing surgical outcomes in ENS patients.

1 | Introduction

The term "empty nose syndrome" (ENS) was coined in 1994 to describe a specific set of symptoms and characteristic image findings following tissue loss [1]. ENS is a debilitating condition characterized by a paradoxical sensation of nasal obstruction despite an objectively patent nasal airway. It often occurs as a complication of excessive nasal turbinate surgery, leading to impaired nasal airflow perception and disruption of normal nasal function [2]. Patients with ENS frequently report symptoms such

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as chronic nasal dryness, dyspnea, suffocation, altered olfactory function, and significant reduction in quality of life. These symptoms are not only physical; they are often accompanied by psychiatric distress, including depression and anxiety, which further compound the disease burden [3, 4].

Sleep disturbances represent a common yet underexplored aspect of ENS. Patients frequently report poor sleep quality, excessive daytime sleepiness, and insomnia, significantly impacting their overall well-being [5]. However, the exact mechanisms linking ENS to sleep disturbances remain unclear. Contributing factors may include impaired nasal airflow, mucosal dryness, and heightened psychiatric distress [5].

Reconstructive surgery, which focuses on restoring nasal airflow dynamics and improving mucosal function, enhances subjective improvements in nasal symptoms, quality of life, and sleep-related outcomes [5–8]. Computational fluid dynamics simulations have demonstrated that surgical reconstruction increases nasal airflow velocity, lateral wall shearing stress, and mucosal cooling during inspiration, which are crucial for maintaining normal nasal physiology [5, 8]. By directing airflow to more functional areas of the nasal cavity, reconstructive surgery helps re-establish more effective mucosal hydration, thermoregulation, and mechanosensory function, thereby improving overall mucosal health. In addition, the increase in nasal nitric oxide levels observed in ENS patients following surgery further supports the restoration of mucosal function [9]. However, these subjective scores may not fully reflect clinically meaningful outcomes. Furthermore, the psychiatric comorbidities frequently observed in patients with ENS may influence post-reconstruction outcomes, including sleep quality [10]. Evaluating these factors is critical to understanding the full scope of surgical efficacy and identifying predictors of meaningful clinical improvement in patients with ENS.

In this study, we aimed to investigate the connection between ENS, sleep disturbances, and psychiatric factors and the impact of reconstruction surgery on these fields, with a focus on meaningful clinical outcomes. Understanding these relationships will help guide clinical decision-making and optimize management strategies for patients with ENS.

2 | Materials and Methods

2.1 | Patient Enrollment

We recruited patients with ENS treated at the Chang Gung Memorial Hospital's Department of Otolaryngology-Head and Neck Surgery. The Institutional Review Board approved this study (IRB No. 202202328B0). The enrollment criteria have been reported in our previous study [11]. Briefly, the inclusion criteria were as follows: (1) typical ENS symptoms (paradoxical nasal obstruction, dryness, diminished airflow, or suffocation); (2) a history of turbinectomy; (3) endoscopic and/or computed tomography confirmation of turbinate volume reduction; (4) positive cotton test; (5) Empty Nose Syndrome 6-Item Questionnaire (ENS6Q) scores of $\geq$ 11 [12]; and (6) patients who eventually underwent endonasal submucosal implantation. The exclusion criteria were as follows: (1) history of any psychiatric disorder or use of antipsychotic medication before initial turbinate surgery; (2) congenital craniofacial anomaly or nasal deformity from trauma or rhinoplasty; (3) other sinonasal conditions, such as nasal polyps or rhinosinusitis; and (4) history of sinonasal neoplasm or radiation therapy.

2.2 | Surgical Intervention and Post-Reconstruction Regimen

All participants underwent surgery performed by the same surgeon. Under transnasal endoscopy, a meticulous incision was made on the nasal floor over the pyriform aperture to create a submucosal pocket. Medpor (Ultra-Thin Sheet Medpor, Porex Surgical, Inc., Newnan, GA, USA), a biocompatible, porous, high-density polyethylene that allows tissue and vascular ingrowth, was used for endonasal submucosal implantation. The Medpor sheet was cut into pieces measuring $8 \times 25\ mm^2$ to $8 \times 40\ mm^2$ and placed within the submucosal space. Then, the elevated mucosal flap was repositioned to cover the augmented area. Nasal packing was placed against the implants in the lateral wall to ensure stability.

Post-reconstructively, all the patients underwent weekly nasal debridement for the first month. Regular endoscopic follow-ups were conducted monthly for the first 6 months, followed by assessments every 2 months.

2.3 | Polysomnography

Each patient underwent full-night polysomnography (PSG) within 24 h pre-reconstructively and 6 months post-reconstructively. Breathing patterns during sleep were scored according to the American Academy of Sleep Medicine criteria [13]. Apnea was defined as a reduction in airflow exceeding 90% for a duration exceeding 10 s. Hypopnea was defined as a reduction in airflow exceeding 30% for at least 10 s, accompanied by oxygen desaturation of $>$ 4% or associated arousal. The apnea-hypopnea index (AHI) was the total number of apnea and hypopnea episodes per hour during sleep.

2.4 | Measurement of Associated Parameters

Age, sex, body mass index (BMI), and any existing comorbidities were recorded for each participant. All participants completed the ENS6Q, Epworth Sleepiness Scale (EpSS), Pittsburgh Sleep Quality Index (PSQI), Beck Depression Inventory-II (BDI-II), and Beck Anxiety Inventory (BAI) questionnaires. These questionnaires were administered twice: pre-reconstructively within a week and 6 months post-reconstructively, as post-reconstruction outcomes have been reported to stabilize within this timeframe [6]. The EpSS, a subjective measure of sleepiness [14], is an eight-question survey consisting of scores ranging from 0 to 24. A score of $\leq$ 10 is considered normal, 11–16 indicates excessive daytime sleepiness, and $>$ 16 indicates severe sleepiness. The PSQI is a widely used questionnaire that assesses various aspects of sleep quality, including subjective quality, latency, duration, efficiency, disturbances, use of sleep medication, and daytime dysfunction [15]. Its scores range from 0 to 21, and scores $>$ 5 indicate poor

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sleep quality. The BDI-II, developed by Beck in 1961 and revised in 1996, assesses depression severity, with scores categorized as 0–13, 14–19, 20–28, and 29–63 for normal, mild, moderate, and severe depressive symptomatology, respectively [16]. BAI, also developed by Beck in 1990, is a 21-item self-report instrument for measuring the severity of anxiety in adolescents and adults, with scores of 0–7, 8–15, 16–25, and 26–63 indicating normal, mild, moderate, and severe anxious symptomatology, respectively [17]. According to previous studies, the minimally clinically important difference (MCID) defines a clinically meaningful improvement as a decrease of at least 4.4 and 3 points in the total PSQI and EpSS scores from baseline, respectively [18, 19].

2.5 | Data Analysis

Statistical analyses were conducted using SPSS Statistics for Windows version 22.0. (IBM Corp., Armonk, NY). Intergroup comparisons of continuous variables were performed using the Mann–Whitney *U* test. In contrast, categorical variables were analyzed using the chi-square test. The pre- and post-reconstruction questionnaire results and PSG parameters were compared using the Wilcoxon signed-rank test. Spearman's correlation analysis was employed to assess the correlation between changes in ENS6Q scores and other subjective measurements. A two-tailed p-value < 0.05 was considered statistically significant.

3 | Results

3.1 | Demographics

Initially, 63 patients were enrolled in this study. However, 24 participants, including seven females, were excluded from the analysis because they refused to undergo post-reconstruction examination. Eventually, 39 patients (33 males and six females) completed all pre- and post-reconstruction assessments, and the mean age was 46.5 ± 12.4 years. The average period between the previous surgery and onset of ENS symptoms was 148.2 ± 109.8 months. Six patients had preexisting chronic medical conditions diagnosed before reconstructive surgery, including hepatitis B virus ($n = 2$), hypertension ($n = 1$), herniated intervertebral disc, dyslipidemia, fatty liver ($n = 1$), gastroesophageal reflux disease, dyslipidemia ($n = 1$), and breast cancer ($n = 1$).

3.2 | Post-Reconstruction Subjective Assessments

The mean scores for the subjective assessments before the reconstructive operation were 18.3 ± 4.8, 22.4 ± 13.2, 24.4 ± 12.8, 12.9 ± 3.9, and 9.2 ± 4.7 for ENS6Q, BDI-II, BAI, PSQI, and EpSS, respectively. These findings indicate that, on average, patients with ENS experienced poor sleep quality and a moderate degree of depressive and anxious traits. The scores of all subjective assessments showed significant improvement post-reconstructively (Figure 1). Furthermore, improvements in PSQI and EpSS scores were positively correlated with improvements in ENS6Q scores (Figure 2).

Additionally, we examined the correlation between post-reconstruction sleep-related subjective assessments and preoperative psychiatric status. Following surgical reconstruction, PSQI scores were not significantly correlated with pre-reconstruction BDI and BAI scores ($p = 0.160$ and 0.603, respectively). Similarly, ESS scores showed no correlation with BDI or BAI scores ($p = 0.755$ and 0.771, respectively). When the enrolled ENS patients were stratified according to their pre-reconstruction psychiatric status, post-reconstruction PSQI and ESS scores did not differ significantly between those with and without depressive symptomatology ($p = 0.140$ and 0.794, respectively). Likewise, post-reconstruction PSQI and ESS scores did not significantly differ between patients with and without anxious symptomatology ($p = 0.691$ and 0.607, respectively).

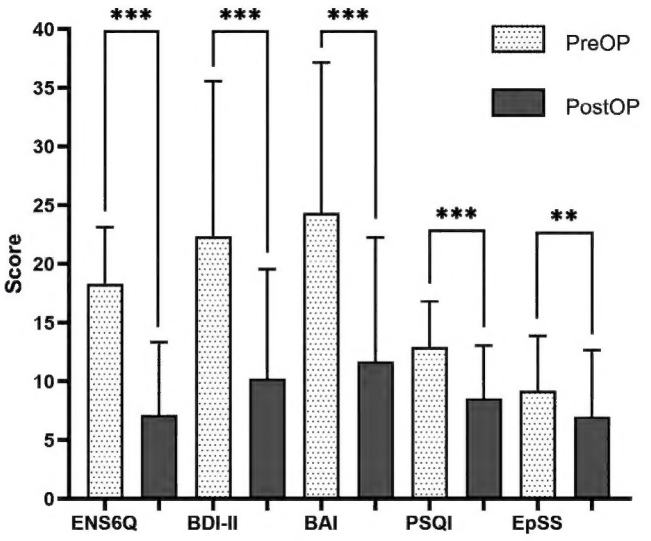

FIGURE 1 | The subjective assessments before and after surgical treatment. Error bars represent standard deviation. ENS6Q, Empty Nose Syndrome 6-Item Questionnaire; BDI-II, Beck Depression Inventory-II; BAI, Beck Anxiety Inventory; PSQI, Pittsburgh Sleep Quality Index; EpSS, Epworth Sleepiness Scale; PreOP, pre-reconstruction; PostOP, post-reconstruction. $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 1 shows the relationship between post-reconstruction psychiatric status and achievement of MCID in the PSQI and EpSS scores following surgery. Following reconstruction, patients who did not develop post-reconstruction depressive symptomatology demonstrated a significantly higher likelihood of achieving MCID in PSQI scores ($p = 0.011$, odds ratio = 13.0). In the PSQI scores, no significant association was observed between post-reconstruction anxious symptomatology and MCID achievement ($p = 0.530$). For the EpSS scores, a non-significant trend was observed, indicating a negative association between post-reconstruction depressive symptomatology and MCID achievement ($p = 0.087$). Similarly, no significant relationship was found between post-reconstruction anxious symptomatology and achieving MCID in EpSS scores ($p = 0.103$).

3.3 | PSG Measurements

Across all PSG parameters, no statistically significant post-reconstruction changes were observed (Table 2). In addition, no significant difference was observed in sleep architecture, including the rapid eye movement sleep, light sleep, and deep

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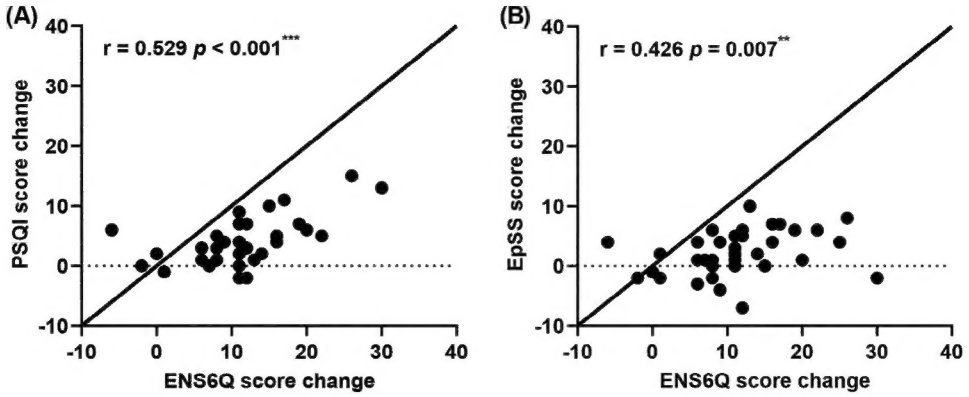

FIGURE 2 | Correlation analysis between post-reconstruction improvements in ENS6Q and (A) improvements in PSQI scores, and (B) improvements in ESS scores. ENS6Q, Empty Nose Syndrome 6-Item Questionnaire; PSQI, Pittsburgh Sleep Quality Index; EpSS, Epworth Sleepiness Scale. $^{**}p < 0.01$, $^{***}p < 0.001$.

TABLE 1 | Association between post-reconstruction depressive traits, anxious traits, and achieving MCID in PSQI and EpSS scores for ENS patients.

	PSQI							EpSS						
	Achieving MCID		Not achieving MCID					Achieving MCID		Not achieving MCID				
	n	%	*n*	%	χ^2 (df)	*p*-value	Phi	*n*	%	*n*	%	χ^2 (df)	*p*-value	Phi
PostOP depressive symptomatology					7.071	0.011*	−0.443					4.179	0.087	−0.327
No	13	92.9	11	50.0				15	83.3	11	52.4			
Yes	1	7.1	11	50.0				3	16.7	10	47.6			
PostOP anxious symptomatology					3.736	0.53	−0.327					3.291	0.103	−0.298
No	10	71.4	8	38.1				12	66.7	7	36.8			
Yes	4	28.6	13	61.9				6	33.3	12	63.2			

Note: The analysis was conducted using a chi-square test. $^{*}p < 0.05$.

Abbreviations: ENS, empty nose syndrome; EpSS, Epworth Sleepiness Scale; MCID, minimally clinically important difference; PostOP, post-reconstruction; PSQI, Pittsburgh Sleep Quality Index.

TABLE 2 | Comparison of pre-reconstruction and post-reconstruction PSG parameters in ENS patients.

Variable ($n = 39$)	Pre-reconstruction	Post-reconstruction	*p*-value
BMI, kg/m^2	25.0 ± 3.3	25.2 ± 3.4	0.188
AHI, events/h	23.1 ± 22.8	27.2 ± 25.1	0.267
AI, events/h	9.7 ± 20.9	11.1 ± 19.3	0.988
HI, events/h	13.4 ± 11.6	16.1 ± 11.7	0.185
Arousal index, events/h	24.3 ± 15.7	26.1 ± 14.6	0.292
Snore index, events/h	261.6 ± 168.6	252.1 ± 169.5	0.667
Mean SpO_2, %	95.5 ± 2.8	93.0 ± 14.0	0.164
Lowest SpO_2, %	85.5 ± 11.5	85.1 ± 9.8	0.592

Note: All values are reported as mean ± SD for continuous variables.

Abbreviations: AHI, apnea-hypopnea index; AI, apnea index; BMI, body mass index; ENS, empty nose syndrome; HI, hypopnea index; PSG, polysomnography; SpO_2, oxygen saturation.

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sleep stages, between pre-reconstruction and post-reconstruction measurements (p = 0.889, 0.950, and 0.983, respectively). The patients were further classified based on their post-reconstruction psychiatric status, revealing the differential impacts of post-reconstruction anxious and depressive traits on snoring outcomes. Patients without post-reconstruction anxious symptomatology experienced a significant decrease in the snore index (SI) after surgery (p = 0.016). Conversely, patients with post-reconstruction anxious symptomatology showed a significant increase in the SI (p = 0.030). However, post-reconstruction depressive symptomatology did not demonstrate a significant relationship with changes in the SI (Figure 3).

4 | Discussion

The factors influencing post-reconstruction sleep outcomes in patients with ENS remain unexplored. In this study, we provided valuable insights into the clinically meaningful improvements in sleep quality and the impacts of post-reconstruction psychiatric status on patients with ENS after reconstructive surgery. In this study, the mean interval between the previous surgery and the onset of ENS symptoms was 148.2 ± 109.8 months. Two review articles have reported that ENS symptoms typically develop gradually over a period ranging from months to years postoperatively [1, 20]. Another study identified a mean duration of 79.8 months from initial turbinate surgery to ENS diagnosis, further highlighting the variability in symptom manifestation [21]. Additionally, it has been noted that the gradual onset of ENS symptoms, coupled with the subjective nature of nasal breathing perception, often leads to diagnostic delays. The significant improvements observed in all subjective questionnaires (ENS6Q, BDI-II, BAI, PSQI, and EpSS) highlighted the effectiveness of reconstructive surgery in alleviating ENS-specific symptoms, psychiatric distress, and sleep disorders. The positive correlation between improvements in the ENS6Q, PSQI, and EpSS scores suggests that addressing the underlying ENS symptoms has a broad impact on sleep quality and daytime sleepiness. These findings emphasize the need for holistic approaches in ENS treatment, considering nasal function and patients' mental and sleep-related symptoms.

Poor sleep quality is associated with cardiovascular diseases, indicating the critical importance of addressing sleep disturbances to reduce the risk of serious systemic health issues [22–24]. Reconstructive surgery had significantly reduced subjective symptom scores; however, only 38.9% and 48.6% of patients with ENS in this study achieved MCID in PSQI and EpSS, respectively. PSQI and EpSS scores did not exhibit significant correlation with pre-reconstruction psychiatric status. However, patients without post-reconstruction depressive symptomatology demonstrated a significantly higher likelihood of achieving MCID in PSQI scores, suggesting that depressive status may hinder perceived improvements in sleep quality. The trend indicating a negative association between post-reconstruction depressive symptomatology and MCID in EpSS scores was not statistically significant; however, it highlights the potential influence of depression on daytime functioning and perceived sleepiness. Notably, post-reconstruction anxious traits did not affect MCID achievement in either the PSQI or EpSS scores. Nonetheless, addressing post-reconstruction mental health remains crucial for optimizing outcomes because untreated psychiatric conditions may limit the overall benefits of surgery. However, given our exclusion of patients with pre-existing psychiatric diagnoses, the observed depressive and anxious traits may have emerged as secondary manifestations of ENS itself. Therefore, the associations identified in this study may not reflect a causal relationship from psychiatric status to sleep outcomes. Instead, improvements in sleep following surgical reconstruction may lead to reductions in psychiatric distress. This potential bidirectional relationship represents a limitation in interpreting our findings.

The prevalence of obstructive sleep apnea (OSA) in the general adult population ranges from 9% to 38% [25, 26]. In contrast, this study reveals a strikingly high prevalence of OSA (89.7%) among patients with ENS, similar to a prior report showing a prevalence of 83.3% [27]. Notably, several hypotheses were proposed to explain this elevated prevalence in patients with ENS. First, excessive nasal airway patency in patients with ENS weakens the ability of the nasal cavity to sense and regulate airflow, potentially disrupting normal breathing patterns and causing airway instability during sleep [8]. Structural changes in the nasal cavity of patients with ENS may alter airflow dynamics, increasing localized negative pressure in the airway and leading to airway collapse or OSA [28, 29]. Furthermore, insufficient nasal airflow perception may reduce sensitivity to carbon dioxide levels, which could further lead to unstable breathing [30]. However, reconstructive surgery for ENS has not been shown to reduce the AHI, suggesting a complex relationship among potentially contributory factors beyond structural restoration. Second, although the mean BMI of patients with ENS in this study is not excessively high (25.0 ± 3.3 kg/m^2), it falls within the overweight range, which may still contribute to developing OSA. Even a modest increase in BMI may be associated with heightened risks of upper airway obstruction during sleep [31]. Third, similar to previous studies, a high prevalence of anxiety (94.9%) and depression (71.8%) in patients with ENS was noted in this study [10, 32]. Research suggests a link between OSA and depression, potentially due to decreased serotoninergic neurotransmission affecting upper airway dilatator motor neurons and increasing the risk of sleep apnea [33–36]. Lastly, patients with ENS often experience paradoxical nasal obstruction, dyspnea, and even feelings of suffocation. These distressing experiences frequently drive patients to rely on mouth breathing, a behavior associated with increased airway resistance, heightened pharyngeal collapsibility, and a greater severity of OSA [37–39].

Excessive nasal patency in ENS reduces airflow resistance and sensory feedback, potentially disrupting breathing rhythm and contributing to central sleep apnea by altering brainstem respiratory control [8]. However, our data in this study indicate OSA is the predominant phenotype, with only two cases classified as central sleep apnea. This finding suggests that while central sleep apnea may play a role in some ENS cases due to impaired neural feedback, the loss of natural nasal morphology and normal airflow remains a primary contributing factor, with the obstructive phenotype being more prevalent. Cases exhibiting a central component warrant further investigation, particularly regarding the impact of nasal sensory deprivation on respiratory regulation.

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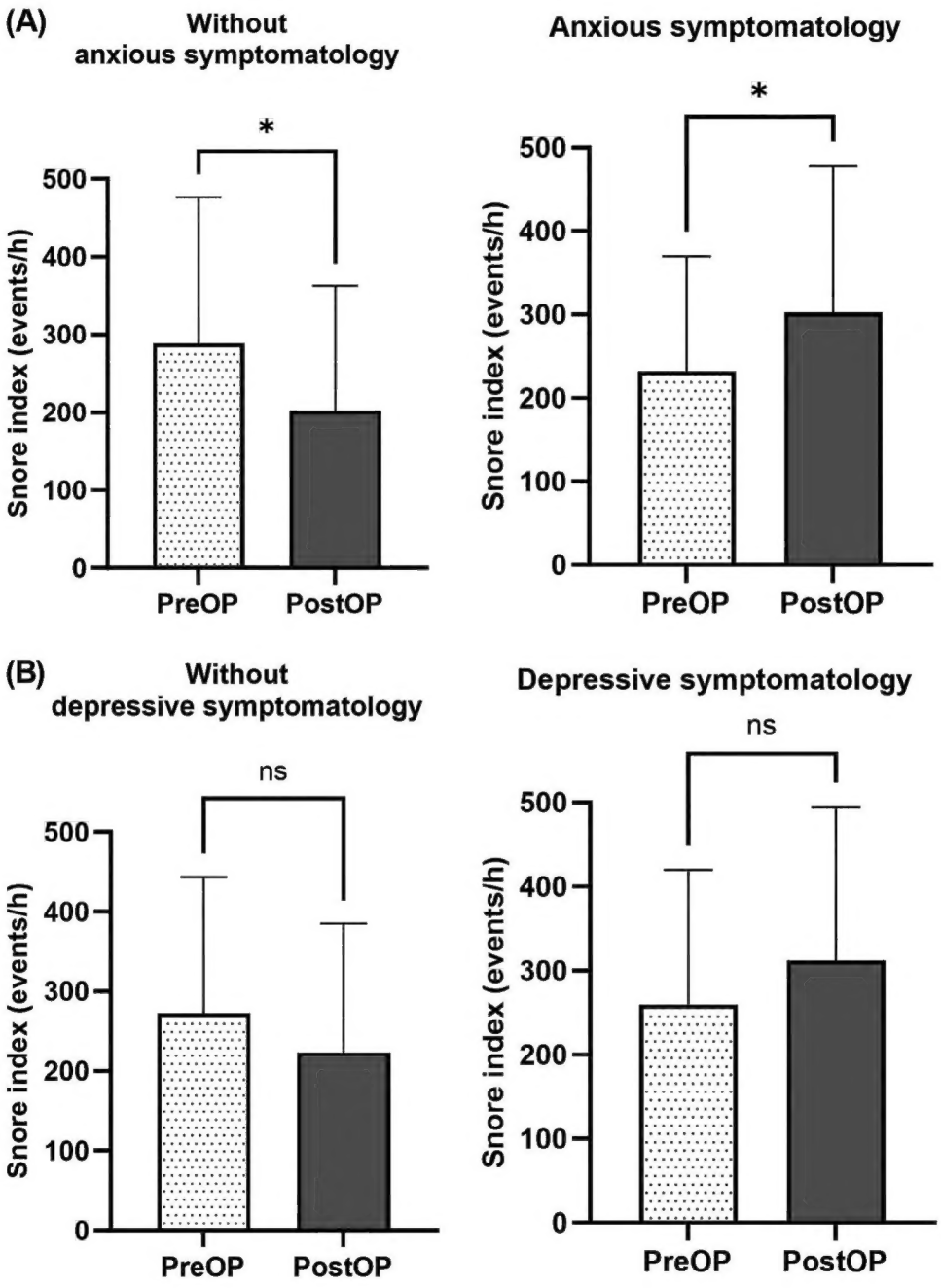

FIGURE 3 | Analysis of the impact of post-reconstruction psychiatric status on changes in snore index, including (A) pre- and post-reconstruction snore index changes in patients without and with post-reconstruction anxious symptomatology, and (B) pre- and post-reconstruction snore index changes in patients without and with post-reconstruction depressive symptomatology. PreOP, pre-reconstruction; PostOP, post-reconstruction; ns, non-significance. $*p < 0.05$.

Our study on patients with ENS demonstrated no statistically significant difference in the SI before and after nasal reconstruction surgery. Six patients in this study had previously undergone oropharyngeal surgery for sleep-disordered breathing before receiving nasal cavity submucosal reconstructive surgery. Following the submucosal implantation, these patients exhibited improvements in subjective symptoms, daytime sleepiness, sleep quality, and snoring severity; however, no significant improvement was observed in OSA. The pattern of postoperative improvement in these patients was consistent with that observed in the remaining 33 patients. Despite the persistence of OSA, none of the enrolled ENS patients requested additional nasal continuous positive airway pressure therapy or oral appliances, likely due to the substantial alleviation of subjective sleep-related symptoms. A longer follow-up period is essential to further elucidate the long-term effects of reconstruction on sleep-related outcomes. On the other hand, the subgroup analysis revealed that post-reconstruction anxious symptomatology was a critical factor influencing snoring outcomes. Patients with post-reconstruction anxious traits experienced statistically

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significant worsening of snoring. Post-reconstruction anxious traits may increase the SI by promoting mouth breathing during sleep, worsening airway instability and snoring severity. This is likely due to anxiety-induced nasal congestion and altered breathing patterns. Previous study suggests anxiety exacerbates congestion via stress-related inflammation or mucus production, forcing mouth breathing [40]. Stein et al. show anxiety disrupts breathing, causing irregular patterns like increased tidal volume variability, potentially shifting patients to oral breathing during sleep [41]. On the contrary, the SI of those without anxiety improved significantly post-surgery. This finding aligns with that of previous studies on patients with OSA, showing that nasal surgeries alone reduce daytime sleepiness and alleviate snoring, but do not lead to significant improvements in AHI [42, 43]. Integrating our findings with these prior results suggests that while nasal function plays a crucial role in snoring, its impact on OSA may be comparatively limited. However, overaggressive nasal interventions leading to ENS may paradoxically exacerbate snoring, especially in patients predisposed to anxiety. The improvement in snoring observed among patients with ENS who did not exhibit post-reconstruction anxious traits emphasizes the potential benefits of nasal reconstructive surgery. These surgeries reduce the need for mouth breathing during sleep by restoring nasal structure and function, which may help alleviate snoring in patients with ENS [44, 45].

This study had some limitations that should be considered. First, the relatively small sample size may restrict the generalizability of the findings, particularly in the subgroup analyses. Recruiting patients with ENS was challenging because the symptoms often take time to manifest. Second, this study did not include a control group because PSG was a self-funded examination, and it was difficult to recruit control participants. A control group should be included in future studies to draw more definite conclusions. Third, the oral and pharyngeal structures were not evaluated in this study. Future research should include an assessment of the upper airway structures to better understand the relationship between ENS and OSA. Fourth, although we excluded patients with prior psychiatric disorders to minimize their impact on surgical outcomes, undiagnosed conditions may still have been present. This exclusion criterion may have limited our ability to fully explore the interaction between pre-existing psychiatric conditions and ENS-related sleep disturbances. Future studies should consider including patients with and without pre-existing psychiatric disorders to determine how psychiatric history influences post-reconstruction outcomes. Additionally, the psychiatric traits identified after reconstruction may have developed as a response to ENS-related distress. This bidirectional relationship complicates interpretation, as it remains unclear whether psychiatric traits influence sleep-related outcomes or whether improvements in sleep quality contribute to a reduction in psychiatric burden during post-reconstruction recovery. Moreover, the study had a 38% dropout rate, which may introduce selection bias and affect the robustness of the findings. Additionally, female participants accounted for only 15% of the study population, potentially limiting the generalizability of results across genders. Lastly, post-reconstruction PSG assessments were conducted 6 months post-surgery. However, the long-term effects of surgery on sleep quality remain unclear. Additional research is required to provide a more comprehensive understanding of the evolution of sleep profiles in patients with ENS.

5 | Conclusion

This study demonstrated significant subjective improvements in sleep quality and daytime sleepiness in patients with ENS after reconstructive surgery, with psychiatric status playing a critical role in post-reconstruction sleep outcomes. No significant changes were observed in the PSG parameters; however, the differential impact of anxious and depressive traits on snoring highlights the importance of addressing psychiatric factors in ENS management. These findings emphasize the need for a multidisciplinary approach to ENS care that integrates surgical, psychiatric, and sleep-focused interventions to achieve optimal patient outcomes.

Acknowledgments

This work was supported by the grants from Chang Gung Memorial Hospital (CMPRG1P0041). The funding agency had no role in study design, data collection, analysis, decision to publish, or manuscript preparation.

Conflicts of Interest

The authors declare no conflicts of interest.

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